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THE GRANDE SOUFRIÈRE OF GUADELOUPE.

BY

EDMUND OTIS HOVEY.

One of the objects of the second expedition sent, in 1903, to the West Indies by the American Museum of Natural History, was the study of the other volcanoes of the Caribbean chain in order to compare them with Mont Pelé and the Soufrière of St. Vincent. In pursuing this study, several days were spent by the author upon the island of Guadeloupe, and two ascents of the Grande Soufrière were made. The visits to the summit of the mountain were favoured by superb weather, and led to the making of observations which may be of general interest, in view of the fact that not much has been published in the United States regarding the volcanoes of the island.

The island of Guadeloupe is the largest of the Lesser Antilles, if we include in our reckoning both parts of the land mass which is intersected by the Rivière Salée. The two portions of the island are entirely distinct in character, the eastern portion, known as "La Grande Terre," being composed of limestone beds of Tertiary Age, while the western portion, known as "Basse Terre," is almost wholly volcanic in origin, and is extremely mountainous in character. The islands called "Les Saintes Îles," which lie to the south of Basse Terre, are the remains of one or more volcanoes.

The limestones which make up the Grande Terre contain abundant corals and other fossils. The beds have been elevated to a comparatively slight degree above sea-level—the highest point is only 450 feet above the sea—and have not been subjected to folding and faulting to any extent. According to Robert T. Hill the limestones form a veneer upon an old eroded foundation of volcanic origin. The southwestern portion of this part of the

island has been extensively eroded, leaving narrow ridges between the streams, while the northeastern portion shows more plateau land intersected by gorges. The topography indicates that there have been here at least two periods of elevation. Low limestones and coral reefs connect Grande Terre with Basse Terre, forming the isthmus which is cut through by the Rivière Salée. These beds extend to the base of the mountains in the northeastern part of the western island. Conglomerate is exposed at various altitudes up to 1,000 feet above the sea at several points of Basse Terre. Coral reefs exist all along the northern and eastern coasts of Basse Terre and along a considerable portion of Grande Terre. Marie Galante, Désirade, and other smaller islands in the immediate vicinity of Grande Terre are likewise of limestone, and show a comparatively young stage of erosion.

The mountains forming the Basse Terre section of Guadeloupe present a series of ancient volcanoes which has been so deeply eroded as to remove any apparent traces of craters from most of them. The movement of volcanic activity appears to have been from the north to the south; at any rate, erosion has proceeded farther at the north than at the south, and the peaks rise to successively greater elevations towards the south, culminating in the Grande Soufrière, which rises to an altitude of 4,868 feet above the sea, and is the highest mountain in the Lesser Antilles. Although the only marked volcanic activity on the islands of Guadeloupe is confined to the Grande Soufrière and its immediate vicinity, the most perfectly-formed crater is that known as "La Citerne," about a mile south of the summit of the Soufrière and at a considerably less elevation. The summit next in elevation to that of the Grande Soufrière is Morne Sans Toucher, which rises $3\frac{1}{2}$ miles N.N.W. of the Soufrière to an altitude of 4,855 feet. Between these peaks rises the Grande Découverte (4,134 feet), while immediately to the southeast of the Soufrière, and between it and La Citerne, is the Morne l'Échelle (4,485 feet). Morne l'Échelle is of particular interest because a series of new and rather active fumaroles has opened upon its northwestern flank facing the Soufrière.

Interest in Guadeloupe centres for the most part about the Grande Soufrière, the summit of which lies about $5\frac{1}{2}$ miles in a straight line northeast of the town of Basse Terre, the capital of the colony. The ascent of the mountain is not a difficult matter, now that the enterprising Club des Montagnards has improved the old paths and opened new ones through the forests on the moun-

tain and has established places of refuge for the comfort and convenience of visitors. The Club was organized April 7, 1903, with M. C. Thionville as President and Dr. C. E. Colardeau as Vice-President. A visit to the summit of the mountain is best accomplished from the town of Basse Terre. The trip may be made in one day, but it is more satisfactorily and comfortably done by driving to Camp Jacob in the afternoon, spending the night there, making the remainder of the ascent the following day and return-

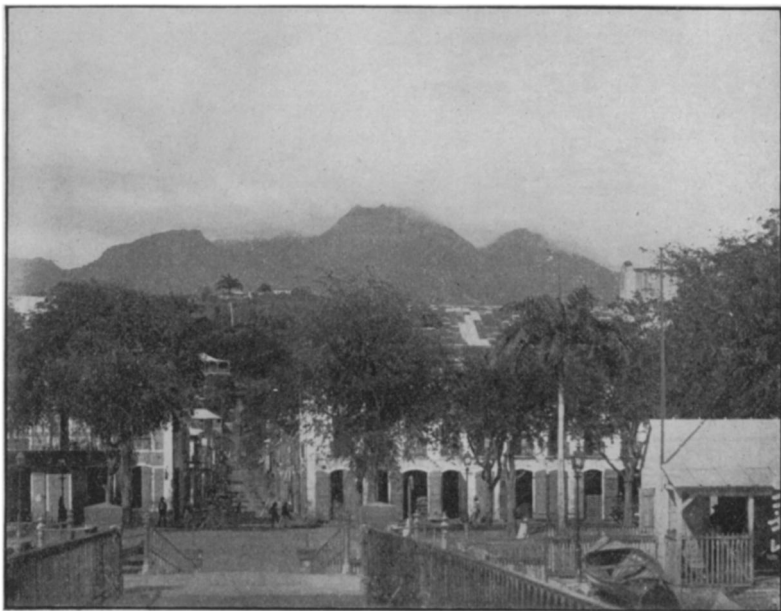


FIG. 1.

THE GRANDE SOUFRIÈRE OF GUADELOUPE FROM BASSE TERRE; DISTANCE $5\frac{1}{2}$ MILES.
PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 16, 1903, BY E. O. HOVEY.

ing to Camp Jacob for the succeeding night. The Club des Montagnards has erected a comfortable cabin at the picturesque Bains Jaunes, at 3,100 feet above the sea, in the upper part of the dense forest, which makes it possible to spend the night within an hour's walk and climb of the summit. Beyond Bains Jaunes, a favourite resort on account of the warm sulphur baths, the forest begins to diminish, and at 4,284 feet above the sea trees cease to grow.

The summit of the mountain is barren of vegetation, except for the wild pineapple, moss, grass, ferns, and similar plants which grow in the hills and in protected places. The gentle treeless slope at the southwestern base of the cone, which goes by the

name of "Mule Savanna"—though no one knows the reason for the appellation—abounds in a beautiful terrestrial orchid. This plant flourishes only between the altitudes of 3,800 and 4,250 feet above the sea, and to enjoy its beauty and its fragrance one must visit its native habitat, for thus far it has resisted all attempts at transplanting.

The seasons of the year must be carefully observed by the traveller who would ascend the Grande Soufrière in such weather as will repay him for his exertions. The mountain is so lofty that its summit forms a region of almost constant atmospheric condensation, and is covered with clouds the major portion of the year. The record of observations by M. Le Boucher* for the year 1898 gives: Entirely free of clouds throughout the course of the day, 27 days; free from clouds at intervals, 103 days; entirely covered, 235 days. A similar record for 1899 gives: Entirely free from clouds during 35 days; free at intervals, 134 days; entirely covered, 196 days. The clearest days may be expected in March and April, when the mountain sometimes remains free from clouds a week or even a fortnight at a time. September also is a favourable month, and three or four days together of clear weather occur occasionally in December and more frequently in January.

Whatever the temperature may be at sweltering Pointe-à-Pitre or at Basse Terre, or even at delightful Camp Jacob, where the Colonial Governor has his residence, one is always sure to have need of warm clothing upon the summit of the Grande Soufrière. A series of observations with a self-registering thermometer, placed in an exposed position where the nocturnal radiation would have its full effect, gave Le Boucher the following record of temperatures:

October 8, 1896.....	— 1° C.
December 27, 1896.....	+ 6° C.
January 2, 1897.....	+ 4° C.
March 15, 1897.....	+ 3° C.
April 6, 1897.....	+ 1° C.

The same author states that on the summit the temperature in the shade during the day does not rise above 18° C. (64° F.) or fall below 7° C. (45° F.). The Club des Montagnards established a barograph and a set of accurate thermometers on the summit in April, 1903, and is carrying on systematic observations on the atmosphere which will provide valuable data for the study of the climate of the high elevations in the Caribbees.

* Léon Le Boucher, "La Guadeloupe Pittoresque," p. 32. Basse Terre (Guadeloupe), 1900.

From Basse Terre the appearance of the profile of the mountains suggests the idea that the cone of the Grande Soufrière rises within the walls of a great crater, the limits of which are indicated by Morne l'Échelle to the south and the height known as the "Nez Cassé" to the north. This impression is dissipated, however, when one stands upon the summit of the mountain and examines attentively the relations of the cone to the surrounding peaks, including those just mentioned.

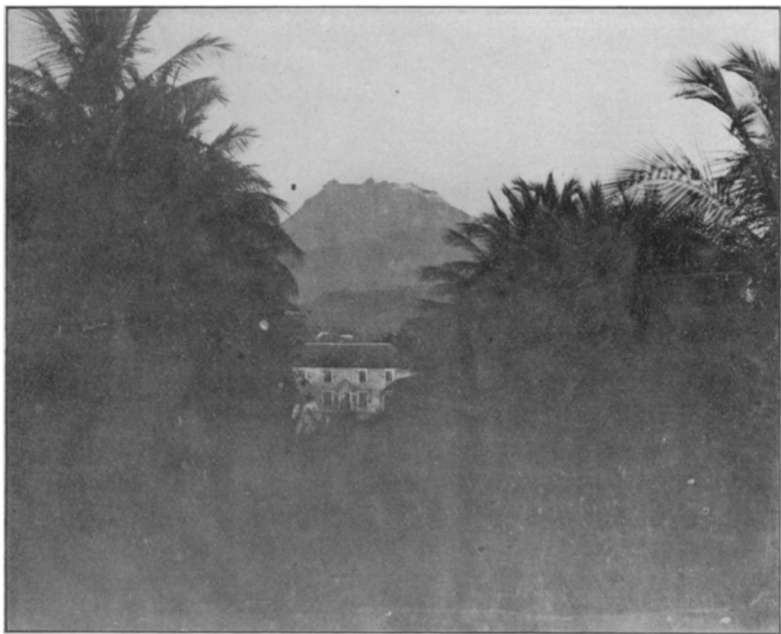


FIG. 2.

THE GRANDE SOUFRIÈRE: SUMMIT FROM THE ROAD FROM BASSE TERRE TO CAMP JACOB. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 16, 1903, BY E. O. HOVEY.

On the north the base of the cone is surrounded by a narrow plateau, which slopes gently southward; that is, toward the cone. Nez Cassé is farther north, across a deep valley. To the southwest the plateau is continued into a rocky ridge extending towards Basse Terre. Towards the east the little plateau merges into the body of the cone, and along the eastern and southern sides cannot be distinguished therefrom. The relationship suggests that the present cone has been formed upon the site of a pre-existent crater which has been obliterated with the exception of the narrow ring upon the north and west sides.

The cone of the Soufrière consists for the most part of solid rock, which projects from the sides in massive buttresses and from the top in jagged pinnacles. The largest of these pinnacles have received distinctive names, such as "Piton du Sud" (or "Piton Dolomieu"), "Piton du Nord" (or "Piton Saussure"), "Portes d'Enfer," "Les Aiguilles," "Piton Breislach," "Dent de l'Est," etc. These various projections above the top of the cone closely resemble the smaller spines and masses formed on the summit of the new cone of Mont Pelé, Martinique, in 1902 and 1903. Between the buttresses of solid lava composing the major portion of the cone a rock formed of débris (tuff agglomerate) may be seen.

There seems to be no definite crater, in the usual acceptation of the term, in the cone of the Soufrière, although there is an irregular depression in the southern half of the summit, which goes by the name of the "Grande Plaine," and there are several smaller hollows. The top of the cone is an irregular plateau about 1,000 feet long from north to south and 850 feet wide from east to west, which is dangerous to traverse away from the beaten paths and the barren rocks by reason of crevices which are concealed by the wild pineapples and the carpet of moss.

The cone is traversed by two series of profound fissures that intersect each other at a small angle near the highest point of the mountain, which is practically the centre of the summit plateau. The largest of these fissures, which preserves a nearly north and south course through the cone, is known as the "Grande Fente," or Great Fissure. At its widest part this cleft is about 75 feet in breadth; its depth varies greatly on account of the material that has fallen in from the sides. At the north end the cleft is open nearly to the base of the cone, and evidently extends to a much greater depth, since this is the location of the principal fumarole of the volcano, which goes by the name of the "Cratère du Nord." Toward the southern side of the cone the Grande Fente forks into two fissures which have not been traced down the slopes of the cone.

For a hundred feet, horizontal measurement, close to the northern edge of the summit plateau, the Grande Fente is very active, steam issuing copiously from at least four openings which comprise the "Fumerolles du Nord." One of these is said to discharge boiling water after a particularly heavy fall of rain. The largest of the vents is a hole, about 9 by 6 inches in dimensions, at the surface of the ground. Steam issued so vigorously here on April 18, 1903, one of the days which the author spent on the summit,

that a stone 6 inches in diameter was supported readily upon the column of vapour, but was not ejected. Considerable sulphurous gas, apparently sulphuretted hydrogen (H_2S), is present in the escaping steam. Sulphur deposits rather rapidly from this in small crystals. On April 17, 1903, the temperature of this fumarole, 6 inches below the surface, was 105°C . The southernmost of the fumaroles was only a scarcely perceptible jet of steam in 1896.

The northernmost of the fumaroles of the Grand Fente are just beyond the edge of the summit plateau. They seem to be two in



FIG. 3.

THE GRANDE SOUFRIÈRE. PITON DU SUD, FROM THE SUMMIT PLATEAU, LOOKING SOUTHWEST.
PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1903, BY E. O. HOVEY.

number, and they comprise the Cratère du Nord. They are the most vigorous of the volcano, and are thought by some observers to have thrown out ashes in January and February, 1903. Doubt is cast upon the value of the observation by the Pelé ash, which was then still to be found on the vegetation of the mountain. These fumaroles are said to have come into activity during the eruption of 1797. They coat the walls of the fissure with a constantly-renewed surface of brilliant sulphur crystals. Sulphur stalactites hang from projecting points of rocks and the air is burdened at times with sulphurous fumes. The steam issues through the great fissure with the force and terrifying noise of an enormous safety-valve.

Rains wash the yellow mineral from the walls down to a pool in a lower part of the Grande Fente, which hence goes by the pretentious name of the "Lac de Soufre." Le Boucher has penetrated the fissure here far enough to see, in a chasm below the upper outlet of the steam, another sulphur lake more worthy the name than that visible from the outside of the fissure.

The temperature of the steam rising from the Cratère du Nord has never been taken, although it would be possible to determine it by means of a self-registering thermometer well incased in metal. The Grande Fente at this point consists of a fissure from one foot to fifteen feet in width, cutting through the solid lava. The rock, which is andesite, is much decomposed. It is roughly columnar in structure, and vertical columns form the walls of the fissure. Observers state that during seasons of abundant rain the volume of steam is greater than it is during dry periods.

Prior to 1843 the Grande Fente was open to the base of the cone, where it enlarged, forming a grotto which was known as the "Caverne de Spallanzani." The cavern was discovered by Peyssonnel, the royal physician living in Guadeloupe about 1730, and a great explorer of the Soufrière. In 1843 a great landslide occurred, which obliterated the lower portion of the fissure and closed the entrance to the cavern, which was below the Lac de Soufre and was about 4,385 feet above sea-level.

The grotto is described as having consisted of three chambers; the first, the walls of which were coated with beautiful crystals [of sulphur?], was about 164 feet in depth, and led to the second, which, according to the enthusiastic writers of the day, presented a magic aspect, the light of the torches being reflected on all sides by the brilliant surfaces of [sulphur?] stalactites* of strangely varied form. The second chamber measured more than 820 feet in depth, beyond which the third chamber opened to unknown extent. The atmosphere of the first chamber was fresh, that of the second was hot and difficult to breathe, while that of the third was irrespirable, extinguishing the torches almost immediately. Terrifying sounds of rushing water issued from the lowest of the three chambers.

A hundred yards to the west of the landslide just mentioned an avalanche occurred in earlier times, leaving a great trench in the lower slopes of the cone. Between these points the side of the cone is covered with loose masses of rock, and the whole is impregnated with sulphur, and has the appearance of freshly-incinerated mate-

* This being a cavern in volcanic rock, calcareous stalactites are, of course, entirely out of the question.

rial. No vegetation exists on this part of the cone, and steam is said to issue from the ground from time to time.

The continuation of the Grande Fente can be readily traced across the little plateau known as the "Savane," which seems to have been the old crater-rim (Morne Amic). Along this extension are situated the new "Fumerolles de Colardeau," four in number,

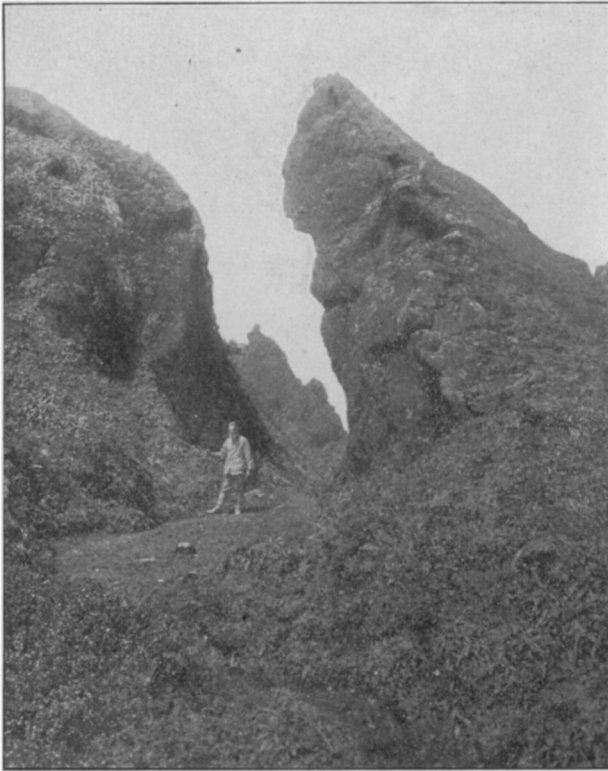


FIG. 4.

THE PORTE D'ENFER! ON THE SUMMIT PLATEAU FROM THE NORTHEAST.
PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1903,
BY E. O. HOVEY.

two of which were discovered on October 28, 1902, by Dr. C. E. Colardeau of Basse Terre. The temperature of the steam issuing from these vents varies from 76° to 92° C. Determinations made April 17, 1903, gave 86° and 88° C. for the two vents on the outer edge of Morne Amic. The steam, which at this time gave only a faint odour of sulphur, was issuing with sufficient pressure to make a low sound. Vegetation was beginning to die in the neighbourhood of the new fumaroles.

Near the centre of the summit plateau, one crosses the Grande Fente, which here trends due north and south, by means of the Natural Bridge, which has been formed by the fall of huge masses of rock from the sides of the fissure. The dangers of this route have been greatly enlarged upon by travellers, and the bridge is so narrow, and the gulf on either side so deep, that one has need

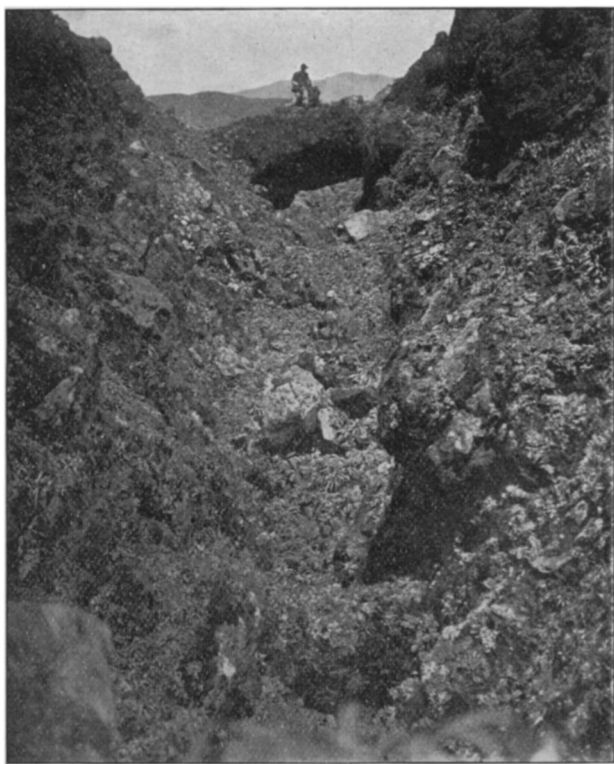


FIG. 5.

THE GRANDE SOUFRIÈRE. THE PONT CHINOIS, A NATURAL BRIDGE ACROSS
THE SECONDARY GREAT FISSURE IN THE TOP OF THE CONE.
PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST.,
APRIL 18, 1903, BY E. O. HOVEY.

of a steady head. The chasm north of the Natural Bridge is called the "Dupuy Gulf," while that to the south is named for a M. Tarissan. These two gulfs or chasms form the most impressive part of the Grande Fente, which is sixty feet wide at the Natural Bridge. The "Tarissan Gulf" is the deeper of the two; accurate measurements are not at hand, but 125 feet would be a moderate estimate for the distance of the lowest visible part of the yawning

chasm below the pathway on the Natural Bridge. A luxuriant growth of ferns carpets the bottoms and sides of these gulfs, the place being protected from the fierce winds which sweep almost constantly over the mountain.

The intersecting fissure, which has a general direction of N. 40° W., is deeply incised along the top of the cone, where it has



FIG. 6.

THE GRANDE SOUFRIÈRE; CENTRAL PORTION OF THE GRANDE FENTE FROM THE SOUTH. THE FISSURE HERE IS ABOUT 75 FEET WIDE AND FROM 50 TO 75 FEET DEEP BELOW THE LOWEST PORTIONS OF THE EDGE. THE BLOCKS, WHICH HAVE FALLEN, HAVE WIDENED THE TOP AND CHOKED THE BOTTOM OF THE FISSURE. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 18, 1903, BY E. O. HOVEY.

a breadth of about forty feet and a maximum depth of fifty to sixty feet. In two places fallen rocks arch across this fissure, forming natural bridges, which are known as "Pont Chinois" and "Pont du Diable." For a hundred yards the chasm is a conspicuous feature of the summit, becoming shallower and narrower toward the north. It is less pronounced on the northern slope,

where it has been christened the "Fente Hovey" by the Club des Montagnards. The fissure may be traced nearly across the Savane at the base of the cone.

To the southwest, across the Grande Fente, the subordinate fissure can be readily traced to the base of the cone. Along a transverse crevice, 75 feet northeast of this fissure, in one of the higher parts of the mountain, are the "Cratères de Napoléon," the best-known, perhaps, of all the vents of the Soufrière. The craters consist of two very strong fumaroles. Steam issues at a temperature of 100° C. Dr. Colardeau reports, "Napoléon was roaring on May 25, 1902." This crater or series of fumaroles is stated to have been formed during the eruption of 1836. The activity is thought to be on the decrease.

Where the northwest-southeast fissure cuts the southern edge of the truncated cone, the chasm, which is less than ten feet wide, is open to a great depth. The trend of the fissure here is about N. 35° W. Exact determination of the depth never has been made, but the reverberations of stones thrown into it are said to have been heard for 17 seconds. The author's observation was that the noise from a descending stone was heard for 14 seconds, which confirms the observations of Le Boucher and others. Le Boucher reports that the last sound coming from a falling rock indicated the existence of a pool of water in the bottom of the chasm. This gulf, which is known as the "Cratère," or "Volcan du Sud," is one of the most impressive features of the Soufrière. No steam issued from it for about ten years prior to 1903. It is now steaming gently, and Dr. Colardeau states that when he visited the locality in 1883 the vent was active.

The fissure continues irregularly down the slope of the cone, and half-way to the bottom there is an old and well-known vent, which was quiet for many years, but which sprang into life again in 1902. This emits steam at a temperature of 98° C., and is one of the indications that the activity of the Soufrière is gradually increasing. The Club des Montagnards has named this vent the "Fumerolle" or "Cratère Lacroix," in honour of the French geologist Professor Alfred Lacroix.

Guadeloupe has long been known as an active volcano. De Rochefort,* in speaking of the island of "Gardeloupe," says:

Certain of these rivers in descending roll along logs of wood coated with sulphur, which have passed by the mines of sulphur which are in one of the most cele-

* *Histoire naturelle et morale des Iles Antilles de l'Amerique*, Chap. 3, Art. V. 8vo. Rotterdam, 1665.

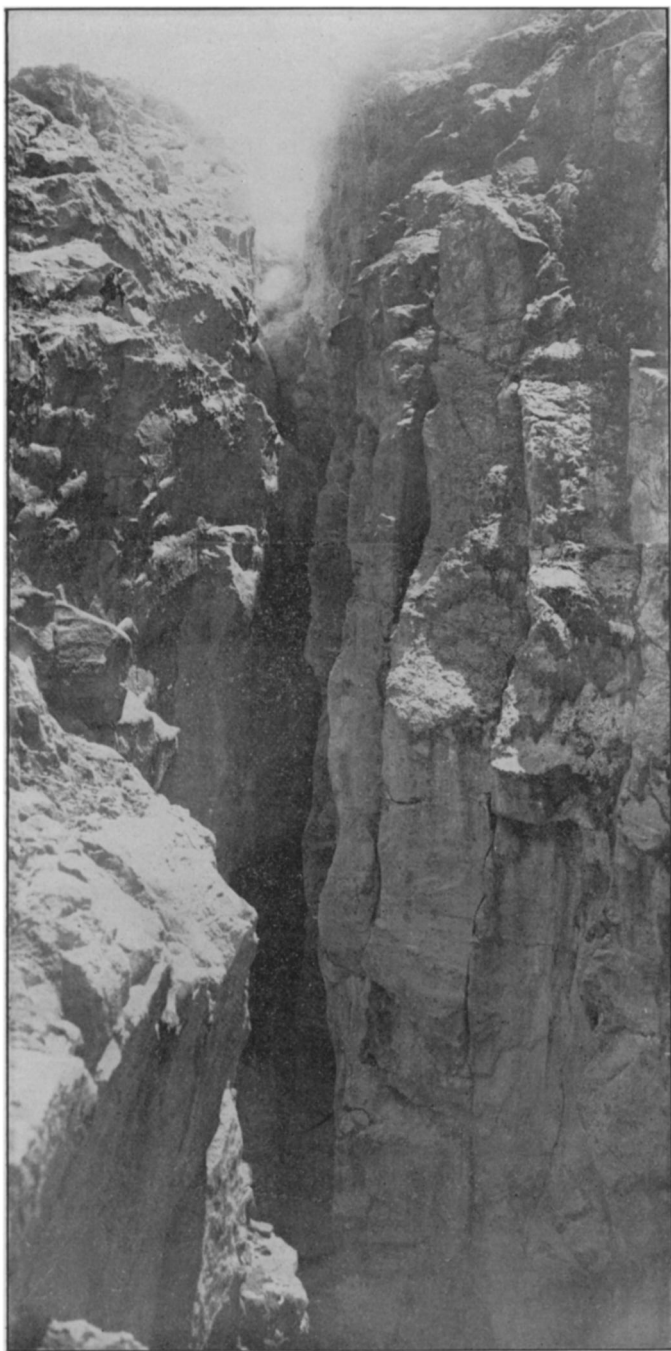


FIG. 7.

THE GRANDE SOUFRIÈRE. THE CRATÈRE DU NORD AND NORTHERN PORTION OF THE GRANDE FENTE. THIS IS THE MOST ACTIVE PORTION OF THE VOLCANO AND IS THE VENT FROM WHICH THE ERUPTION OF 1797 TOOK PLACE. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1903, BY E. O. HOVEY.

brated mountains of the island, which vomits smoke continually and to which there has been given on this account the name of the "Soufrière." There are also springs of boiling water

The first eruption of the Grande Soufrière in historic times took place in September [1796?] 1797, after a series of earthquakes. Terrible rumblings were heard in the mountain, and a fine rain of cinders spread itself over the heights of Matouba, which lie north-west of the mountain. During this eruption the top of the Piton Breislach was broken off by the earthquakes and the Cratère du Nord came into activity. The next eruption, and the only other which has been recorded, occurred on December 3, 1836. This likewise was characterized by an abundant rain of cinders. It had the effect of extinguishing all the vents of the north and of concentrating the volcanic activity to the south and to the east. During this eruption, the Cratère Napoléon, which is the best-known of all the fumaroles of the Soufrière, came into existence.

Kingsley* states that "smoke by day and flame by night—or probably that light reflected from below, which is often mistaken for flame in volcanic eruptions—have been seen again and again above the craters." There seems, however, to be some doubt as to the accuracy of the statement that any incandescent matter has been visible in the mountain for many years; at any rate no mention of such a phenomenon was made to the author by MM. Thionville, Colardeau, and Le Boucher. On the slope of Morne l'Échelle, M. Thionville pointed out to the author a "bread-crust" bomb of pumice which apparently had come from some ancient eruption of the Soufrière. It was much decomposed, but its character was still plainly evident from the old densely-vitreous surface being preserved, and its appearance was that of many of the bombs thrown out by Mont Pelé in 1902. Other similar "bread-crust" bombs have been found near Basse Terre and elsewhere, photographs of two of which have been communicated by Dr. Colardeau. Many blocks of pumice lie upon the surface of the mountain slopes:

The great eruptions on Martinique and St. Vincent in 1902 naturally directed much attention to the Grande Soufrière of Guadeloupe, the more so on account of the fumarole area which has opened on the north flank of Morne l'Échelle in the valley between that peak and the cone of the Soufrière. The activity of this new area was first observed by Le Boucher in 1894. Since that time the activity has gradually increased and new vents have been opening in an irregularly oval area, the axis of which is about N.N.E.—

* "At Last." London, Macmillan, 1874, p. 39.

S.S.W. in direction. Early in 1898 the new fumaroles first became visible from Basse Terre, and even from Pointe-à-Pitre, and during the year the vegetation was destroyed over an area of rather more than an acre about the vents. The ground, too, became hot to the touch, and could not long be endured by the barefooted



FIG. 8.

THE GRANDE SOUFRIÈRE. THE CRATÈRE DU SUD: SOUTHWESTERN PORTION OF THE INTERSECTING FISSURE. THIS NARROW CHASM IS SO DEEP THAT THE REVERBERATIONS OF A FALLING STONE ARE HEARD FOR FOURTEEN SECONDS. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 18, 1903, BY E. O. HOVEY.

guides. At the time of the author's visit to the region in April, 1903, the vegetation had been killed over a plot ten or twelve acres in extent.

There are many steam vents here, but their number and position change somewhat from time to time. Certain of them are "dry" vents—that is to say, nothing but steam issues from them; others are "wet" fumaroles—that is, the steam issues through a

spring of boiling mud similar in character to the "paint-pots" of the Yellowstone Park geyser region. The largest of these boiling mud springs were about six feet across in April, 1903, whereas they were only six inches in diameter when first noticed by M. Thionville six years before. From time to time the activity in these wet fumaroles increases sufficiently to throw the mud in geyser-like outbursts to a distance of a few feet from the orifice, but there is no regularity about the intervals at which this happens. The temperature observed April 17, 1903, was 96° C. in the largest of the wet fumaroles. Dr. Colardeau states that the temperature of the l'Échelle fumaroles rose to 110° C. by December 6, 1903, but that it diminished again to 103° C. in the following six months. The vapour issuing from the dry fumaroles apparently contains more sulphur than that from the wet. This seems to be in the form of hydrogen sulphide (H_2S), from which the sulphur deposits readily on leaves, twigs, and other objects in the form of minute crystals.

On the slopes of Morne l'Échelle, to the northeast of this fumarole area, a new series of vents was observed in the spring of 1903. These were steaming rather copiously at the time of the author's visit, as was also a still more recent vent in the middle of the east slope of the Grande Soufrière, but neither locality was visited for lack of time to cut a pathway through the dense growth of wild pineapple covering the mountain.

Between the western slopes of Morne l'Échelle and the base of the cone of the Grande Soufrière lies the gorge of the Matylys, which is the site of several cold, warm, and hot springs the water of which is more or less impregnated with sulphur and alum. The trail lies along this gorge, and is often rendered impassable by the torrents following the deluges which characterize the tropical showers in the mountains. Leaving the Matylys, the trail traverses the dense thickets of mountain mangrove at the southern base of the great cone. Here are to be seen the Sources du Galion, warm and hot sulphur springs discharging their waters into the Galion River, the torrential stream which reaches the sea near Basse Terre. The springs are eight in number, and they vary in temperature, according to Le Boucher, from 65° C. to 73° C. Each varies considerably, furthermore, from time to time. One spring, for instance, showed a temperature of 37° C. in the fall of 1889, 55° C. in 1893 and 73° C. in 1899. In general there has been a rising of temperature, but the increase has not been general or uniform. Many other warm and hot springs are known throughout the island of Basse Terre, indicating that the activity of the volcanic centres

of the island, though dying, is not altogether extinct, even aside from the Grande Soufrière and the immediate vicinity.

The increase in the activity which has been going on at the Soufrière of Guadeloupe for about ten years is a matter of serious concern to the inhabitants of the island, who are in constant dread lest their volcano should prove as disastrous a neighbour to them as Mont Pelé was to St. Pierre. It is impossible to predict the



FIG. 9.

THE NEW FUMAROLE AREA ON THE NORTHERN SLOPE OF MORNE L'ECHELLE. HERE THE VEGETATION HAS BEEN DESTROYED OVER AN AREA OF TEN OR TWELVE ACRES BY THE FUMARoles WHICH HAVE COME INTO ACTIVITY SINCE 1894. PHOTOGRAPHED FOR THE AM. MUS. NAT. HIST., APRIL 17, 1904, BY E. O. HOVEY.

future of a volcano about which so little is definitely known as the Soufrière of Guadeloupe. It is safe to say, however, that the increase of activity has been so gradual that there seems to be no imminent danger of an eruption, and that the present may be one of the periodic increases which have characterized the history of the volcano for generations. Furthermore, the configuration of the mountain is such that no blast could issue from it concentrated in a narrow zone in the manner that proved so destructive to St. Pierre. If an eruption should make use of the present fissures in the cone, the maximum violence would probably be exerted in a

northerly and southerly direction, so that the area of devastation would be an ellipse, the longer axis of which would be from north to south, and the phenomena would resemble those of the Soufrière of St. Vincent rather than of Mont Pelé. There would be danger of the destruction of Camp Jacob and the plantations along the middle slopes of the mountain, but the warnings of an imminent eruption would, perhaps, be heeded by the inhabitants, after the experience of the dwellers upon the slopes of Mont Pelé.

THE DISPROOF OF THE EXISTENCE OF REED OR REDFIELD ROCKS.

BY

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For fifty years mariners continued to believe, or to be unable to disbelieve, in the existence of dangerous rocks in the Pacific Ocean, in a position about seven hundred miles westward of San Francisco. In 1850 Captain Reed, of the brig *Emma*, reported that he had seen two rocks, measuring from six hundred to nine hundred feet long, and from two hundred and fifty to four hundred feet broad, and having a depth of about three fathoms of water over them, in latitude $37^{\circ} 24'$ north and longitude $137^{\circ} 22'$ west of Greenwich; and in 1851 a report came from the U. S. sloop-of-war *Falmouth* confirming the existence of rocks in this geographical position. Captain Redfield, of the whaler *Susan Abigail*, also reported in 1856 that he had discovered some rocks, with about ten feet of water over them, in a geographical position eleven miles to the northward of the geographical position stated by Captain Reed; and in 1866 rocks were again said to have been seen by Captain Cave, whose report assigned to them a position one mile to the northward and five miles to the eastward of the geographical position agreed upon by the original authorities. Commander Franklin, of the U. S. S. *Mohican*, reported in 1870 that the office of the harbour-master at Honolulu contained records showing that the ships *Kuttosoff* and *Eliza Kimball* had found these rocks, which by that time had come to be known as Reed or Redfield Rocks, and that the latter ship had anchored in five fathoms of water there, and described three of the rocks as extending considerably above the surface of the water.